**Abstract:** A rainwater harvesting system which utilises facade cladding instead of roof collection. The system uses the structural 'transoms' or horizontal glazing members to direct rainwater falling on the glazing panels into the vertical mullions, and from there downwards into a basement collection system as with more conventional rainwater harvesting. Embodiments are described including a slotted enclosed system, with lift out panels for cleaning, and an open system with easier cleaning access. Both embodiments allow rainwater to be collected before ground contamination occurs, making its filtration and reuse within the building easier. It also means that urban buildings can now seriously benefit from rainwater harvesting and reduce their water consumption in a way that only buildings with larger roof areas were able to before.
Facade Rainwater Harvesting System

The present invention relates to rainwater harvesting systems on buildings and in particular to a rainwater harvesting system which uses structural ‘transoms’ or horizontal glazing members to direct rainwater falling on the glazing panels into the vertical mullions, and from there downwards into a collection system.

Currently there is great interest in harvesting rainwater from buildings in order to reduce demand on the mains supplies. This traditionally has been based on collection from roofs. For example, GB 2 228 521 describes a roof tile rain collector having a trough and a collector for water and snow to be collected from various roof types. Further designs have been based on collecting the rain water from the roof tiles directly. GB 2 291 924 describes roof tiles including an integral reservoir accessed via openings on the upper surface of the tile.

In urban areas however with multi storey buildings the roof area is proportionally much smaller and often the opportunity for rainwater collection is considered inadequate. However, often in the UK, and perhaps increasingly, rain falling is wind-driven, hence the term ‘driving rain index’. As a result most rain falls on the vertical surfaces of buildings. Traditionally facades cladding these surfaces are designed to shed water as fast and efficiently as possible, discharging to ground where it is disposed of through land drainage.

It is an object of the present invention to provide a method and apparatus for rainwater harvesting which obviates or mitigates at least some of the disadvantages of prior art harvesting systems.
According to a first aspect of the present invention there is provided a method of collecting rainwater from a building, the method comprising the steps;

a) locating one or more channels horizontally across a vertical façade of the building;

b) arranging the channels to intercept rainwater being shed from the vertical facade;

c) directing the rainwater into vertical mullions; and

d) collecting the directed rainwater.

Preferably, the channels are located in structural members of the building.

Preferably, the vertical façade from which the water is collected comprises weather sealed intermediate cladding panel areas.

Preferably, the method includes the step of additionally collecting rainwater from a roof of the building via roof line guttering connected to the vertical mullions.

Preferably, the method includes the step of treating the collected rainwater. Additionally, the method may include the step of reusing the collected rainwater within the building.

According to a second aspect of the present invention there is provided apparatus for the collection of rainwater from a building comprising one or more vertically arranged mullions to channel rainwater collected from a roof to a lower level and a vessel to store the collected rainwater for distribution, characterised in that:

one or more transom collector members are arranged horizontally to and spaced apart along the length of the one or more mullions, each transom
collector member including a channel to collect rainwater from the vertical façade of the building and an aperture located between the channel and the vertical mullion to direct the collected rainwater into the mullion.

Preferably, the transom collector members are integral with external cladding of the building. Alternatively or additionally each transom collector member may be integral with a metal framing grid around a cladding panel.

In this way, a rainwater collection and harvesting system is provided which may be integral with the external cladding of a building, particularly vertical cladding comprising infill panels to a hollow metal framing grid which is designed or modified to intercept, collect and channel rainwater falling on the facades and conduct same to temporary storage, treatment and reuse.

Preferably, the channel is located in a box section creating a larger structural portion which is arranged outermost for exposure to the weather. The box section may be subdivided by a stiffening member to create a closed chamber for structural properties and an open chamber forming the channel for the collection of rainwater.

Preferably, the apparatus includes a directing means to direct the rainwater from the vertical façade into the channel. Preferably, the directing means is a seal located between the box section and the external cladding.

Preferably, the transom collector members include an upper face which is open for the passage of rainwater into the channel. Optionally, the transom collector members include lift out sections. The transom collector members may include a cover over the upper face and wherein the cover
includes apertures for the rainwater to pass therethrough. Preferably, the apertures are open collection slots. Alternatively, the cover is a perforated grating.

Preferably, a seal is located between the transom collector member and the mullion at the aperture. Preferably, the apparatus is arranged as a hollow grid of vertical mullions sealed to horizontal collector transom members.

Preferably, the apparatus further comprises a shaped shoe to connect to the foot of the vertical mullion to rainwater pipework to conduct collected rainwater to the storage vessel. The shaped 'shoe' may be a section in aluminium or other non-ferrous metal sealed by neoprene or EPDM gaskets, to connect the foot of vertical mullions to rainwater collection pipework in aluminium or other non-ferrous metal or plastics material to conduct collected rainwater to storage vessel.

Preferably, the apparatus includes means to filter the collected rainwater. Preferably also, the apparatus includes a pump to pump the collected rainwater to roof level. More preferably, the apparatus includes a gravity feed system to direct collected rainwater to parts of the building.

According to a third aspect of the present invention there is provided a framing section for use in the apparatus of the second aspect, the framing section comprising a frame adapted to surround at least a portion of a cladding panel, the frame including a portion having a box section attached thereto, the box section including the channel, and at least one weatherseal arranged to seal the box section to the cladding panel and direct rainwater from the cladding panel into the channel.
In this way, a metal framed cladding system can be formed, comprising a hollow grid of vertical mullions sealed to horizontal transoms which are open to their upper faces, either by perforated gratings with lift-out sections or fully open, to intercept and channel rainwater which falls over the weather sealed intermediate cladding panel areas, and conduct it to the closed vertical Mullions for disposal downwards to temporary storage, treatment and reuse.

Additionally, a metal framing section can be formed with weatherseals and capacity for pressure sealing gaskets to intermediate cladding panels of glass or another material, such section intended for use horizontally, with its larger (structural) portion outmost exposed to the weather, and in section subdivided either diagonally or in another fashion to create a closed chamber for structural properties, and an open chamber for the collection and conduct of rainwater to void within vertical framing.

Preferably, the framing section includes a compression plate to hold the box section outwardly, in use.

Preferably, the box section is subdivided by a stiffening member to create a closed chamber for structural properties and an open chamber forming the channel for the collection of rainwater. Preferably also, the box section includes an upper face which is open for the passage of rainwater into the channel. Advantageously, the box section includes lift out sections. Preferably also, the box section includes a cover over the upper face and wherein the cover includes apertures for the rainwater to pass therethrough. The apertures may be open collection slots. In an embodiment the cover is a perforated grating.
According to a fourth aspect of the present invention there is provided a panel for use in a building including the apparatus according to the second aspect, wherein the panel comprises a cladding panel and a framing section according to the third aspect.

Preferably, the cladding panel is a curtain walling screen. Alternatively, the cladding panel is a glazing panel.

Embodiments of the present invention will now be described, by way of example only, with reference to the accompanying drawings, of which:

Figure 1(a) is a schematic illustration of apparatus for the collection of rainwater from a building according to an embodiment of the present invention;

Figure 1(b) is a schematic illustration of a transom collector and mullion connection of Figure 1(a);

Figure 1(c) is a part cross-sectional view through a part of the connection of Figure 1(b);

Figure 1(d) is a cross-sectional view through the connection between the transom collector and the glazing panel of Figure 1(a);

Figure 1(e) is a schematic illustration of the shoe connector of Figure 1(a);

Figure 2 is a diagrammatic section through a rainwater harvesting system according to a further embodiment of the present invention;

Figure 3 is a schematic illustration at the roof line of the system of Figure 2;
Figure 4 is a schematic illustration of the rainwater harvesting system of Figure 2;
Figure 5 is a cross-sectional view through the connection between the transom collector and the glazing panel of an alternative embodiment;

Figures 6(a) - (c) are plan detail, section detail and alternative section detail, respectively, of a connection between a transom collector and panels of a further embodiment; and

Figures 7(a) - (c) are plan detail, section detail and elevational detail, respectively, of a connection between a transom collector and panels of a yet further embodiment.

Referring initially to Figure 1 of the drawings there is illustrated apparatus for the collection and harvesting of rainwater from a building, generally indicated by reference numeral 10, according to an embodiment of the present invention. Apparatus 10 is upon a substantially vertically arranged wall or façade 12 of a building (not shown). Vertically arranged mullions 14 in the form of ducts or channels are arranged at intervals along the wall 12. The mullions 14 may be down pipes or drainpipes as are known in the art. Preferably the mullions are of square or rectangular cross-section for ease of connection. The mullions may be constructed of aluminium or other suitable material.

The wall 12 comprises a pattern of panels 16. The panels may be glazing or could be of any cladding as is known in construction. For example the vertical cladding could be infill panels to a hollow metal framing grid. The panels are arranged in a substantially vertical configuration such that rain hitting the panels will run down the face thereof to their base. Between the
mullions 14 there are located transoms 18. The transoms 18 form substantially horizontally arranged channels at or near the base of each panel 16. While the transoms 18 are illustrated as symmetrically arranged at either side of the mullions 14, this is not essentially and they may be arranged at any position between adjacent mullions 14.

The transoms 18 have ports 20 located therein so that rainwater collecting on the outer surface of the panels 16 runs into the channels 22 of the transoms 18. The rainwater is ducted to the mullions 14 where it falls and is directed via a shoe 24 to a base collector duct 26.

Reference is now made to Figure 1(b), which shows the connection of the transom 18 to a mullion 14. It is seen that the mullion 14 includes a mounting arrangement of a T-bar for locating the mullion between adjacent panels 16. A simple box fitting is used to connect the transom 18 to the mullion 14, as shown in Figure 1(c). A gasket seal can be arranged at the connection. The transom 18 is connected into the panels 16 at their base, as illustrated in Figure 1(d). Those skilled in the art will appreciate that glazed panels have an aluminium frame surrounding the dual panels.

Typically a box section is positioned on an inner surface of the glazing. The present invention can be considered as a modified and 'inverted' design of patent glazing or curtain walling screen to intercept and collect the rainwater from facades. The system comprises an inverted design of screen assembly, with box sections projecting outwards instead of inwards. By using aluminium box sections of the screen assembly as transoms, the apparatus 10 can be formed as a frame section, a cladding panel including the frame section or the entire rainwater harvesting system with mullions and collection and recycling components.
The transoms 18 can be joined to the panels by means of a compression plate 28 located on the opposing side of the panel 16. Seals 30 are located above and below the transom 18 to direct the rainwater from the front surface of the panel 16 into the channel 22 and maintain the seal integrity of the double glazed panel 16. The seals may be weatherseals as are known in the art and provide pressure seal gaskets at these locations. Seals can also be located between the transoms 18 and the mullions 14.

The channels 22 can be stiffened through additional supports located therein. This may be required for longer distances of transoms 18. The slots 20 may be incorporated in a removeable cover which allows the channels 22 to be conveniently cleaned. The slots may be of any shape and configuration such as slots. A grating could also be used. A cover is required to prevent leaves and debris clogging up the apertures between the mullions 14 and the transoms 18. Alternatively lift out sections may be used to enable cleaning.

Structural connections, if steel, are connected to flanges formed on the outside of the box section. The interior of the mullion box sections is kept clear of structural or other intrusions,

At the base of each mullion 14 is a shaped shoe to connect to the foot of the vertical mullion to rainwater pipework to conduct collected rainwater to the storage vessel. This is as shown in Figure 1(e). The shaped 'shoe' may be a section in aluminium or other non-ferrous metal sealed by neoprene or EPDM gaskets, to connect the foot of vertical mullions to rainwater collection pipework in aluminium or other non-ferrous metal or plastics material to conduct collected rainwater to a base collector duct 26.
Reference is now made to Figures 2, 3 and 4 which illustrate the additional components for an entire rainwater collection and harvesting system, generally indicated by reference numeral 32. In this embodiment rainwater can additionally be collected from available roof space 34. The rain collected from the roof 34 is directed to roof-line or roof-edge guttering 36 as presently exists. These gutters 36 are connected to the vertical mullions 14 and aid in water collected in the mullions 14. Mullion sizes can be altered to suit predicted rainwater capacity. The water collected in the mullions 14 from the gutter 36 and the transoms 18 is directed via the shoes 24 into a base collector 26.

The base collector ducts the water to a storage vessel 38 in a basement level or ground floor level. The storage vessel 38 will be fed from any number of base collectors and may be considered as a harvest tank. This stored water may then be filtered 40 and pumped 41 to a tank 42 at an upper location or roof level in the building. The water can then be distributed by typical gravity feed for use throughout the building such as flushing toilets, or cleaning and maintenance.

Reference is now made to Figure 5 of the drawings which shows a design with increased structural strength and an open top area, giving a gutter zone more easily cleaned out of sediment. Drainage holes into the vertical mullions are then either drilled holes, or shaped holes, with seals as previously. The stiffening member used to create the gutter can be angled to direct the rainwater as desired.

From the drainage holes the water ducts into apertures formed in the vertical aluminium mullions through gasket-sealed connections. The mullions act as rainwater conduits down to the ground floor or basement.

At this point the water is collected horizontally and ducted to a storage
vessel. From here it is filtered as with conventional rainwater harvesting systems and pumped to roof level for gravity distribution as above.

Further arrangements are illustrated in Figures 6 and 7. These show the components used in place of the compression plate 28. In Figure 6, a box section 48 extends on the inside of the panel 16. The compression screw can be applied from inside the channel 22. In Figure 7, a seal 50 is located within the panel 16 to provide a flush inner surface. In this arrangement the compression screw can be inserted from the inside.

A principal advantage of the present invention is that it provides a rainwater collection and harvesting system which may be integral with the external cladding of a building, particularly vertical cladding comprising infill panels to a hollow metal framing grid which is designed or modified to intercept, collect and channel rainwater falling on the facades and conduct same to temporary storage, treatment and reuse. In this way, for buildings with a lower roof surface area to wall surface area, a rainwater collection system can be viable.

A further advantage of at least one embodiment of the present invention is that it provides a metal framed cladding system, comprising a hollow grid of vertical mullions sealed to horizontal transoms which are open to their upper faces, either by perforated gratings with lift-out sections or fully open, to intercept and channel rainwater which falls over the weather sealed intermediate cladding panel areas, and conduct it to the closed vertical mullions for disposal downwards to temporary storage, treatment and reuse.

A yet further advantage of at least one embodiment of the present invention is that it provides a metal framing section which can be formed
with weatherseals and capacity for pressure sealing gaskets to intermediate cladding panels of glass or another material, such section intended for use horizontally, with its larger (structural) portion outmost exposed to the weather, and in section subdivided either diagonally or in another fashion to create a closed chamber for structural properties, and an open chamber for the collection and conduct of rainwater to void within vertical framing.

Modifications may be made to the invention herein described without departing from the scope thereof. For example, the transoms may be of any shape or material as can the mullions. The apparatus can be incorporated with known roof based rainwater harvesting systems.
CLAIMS

1. A method of collecting rainwater from a building, the method comprising the steps;
   a) locating one or more channels horizontally across a vertical façade of the building;
   b) arranging the channels to intercept rainwater being shed from the vertical facade;
   c) directing the rainwater into vertical mullions; and
   d) collecting the directed rainwater.

2. A method according to claim 1 wherein the channels are located in structural members of the building.

3. A method according to claim 1 or claim 2 wherein the vertical facade from which the water is collected comprises weather sealed intermediate cladding panel areas.

4. A method according to any preceding claim wherein the method includes the step of additionally collecting rainwater from a roof of the building via roof line guttering connected to the vertical mullions.

5. A method according to any preceding claim wherein the method includes the step of treating the collected rainwater.

6. A method according to any preceding claim wherein the method includes the step of reusing the collected rainwater within the building.
7. Apparatus for the collection of rainwater from a building comprising one or more vertically arranged mullions to channel rainwater collected from a roof to a lower level and a vessel to store the collected rainwater for distribution, characterised in that:

one or more transom collector members are arranged horizontally to and spaced apart along the length of the one or more mullions, each transom collector member including a channel to collect rainwater from the vertical façade of the building and an aperture located between the channel and the vertical mullion to direct the collected rainwater into the mullion.

8. Apparatus according to claim 7 wherein the transom collector members are integral with external cladding of the building.

9. Apparatus according to claim 8 wherein each transom collector member is integral with a metal framing grid around a cladding panel.

10. Apparatus according to any one of claims 7 to 9 wherein the channel is located in a box section creating a larger structural portion which is arranged outermost for exposure to the weather.

11. Apparatus according to claim 10 wherein the box section is subdivided by a stiffening member to create a closed chamber for structural properties and an open chamber forming the channel for the collection of rainwater.

12. Apparatus according to any one of claims 7 to 11 wherein the apparatus includes a directing means to direct the rainwater from the vertical façade into the channel.
13. Apparatus according to claim 12 wherein the directing means is a seal located between the box section and the external cladding.

14. Apparatus according to any one of claims 7 to 13 wherein the transom collector members include an upper face which is open for the passage of rainwater into the channel.

15. Apparatus according to claim 14 wherein the transom collector members include lift out sections.

16. Apparatus according to any one of claims 7 to 13 wherein the transom collector members include a cover over the upper face and wherein the cover includes apertures for the rainwater to pass therethrough.

17. Apparatus according to claim 16 wherein apertures are open collection slots.

18. Apparatus according to claim 16 or claim 17 wherein the cover is a perforated grating.

19. Apparatus according to any one of claims 7 to 18 wherein a seal is located between transom collector member and the mullion at the aperture.

20. Apparatus according to any one of claims 7 to 19 wherein the apparatus is arranged as a hollow grid of vertical mullions sealed to horizontal collector transom members.
21. Apparatus according to any one of claims 7 to 20 wherein the apparatus further comprises a shaped shoe to connect to the foot of the vertical mullion to rainwater pipework to conduct collected rainwater to the storage vessel.

22. Apparatus according to any one of claims 7 to 21 wherein the apparatus includes means to filter the collected rainwater.

23. Apparatus according to any one of claims 7 to 22 wherein the apparatus includes a pump to pump the collected rainwater to roof level.

24. Apparatus according to claim 23 wherein the apparatus includes a gravity feed system to direct collected rainwater to parts of the building.

25. Apparatus according to claim 8 or claim 9, further comprising a framing section having a frame adapted to surround at least a portion of a cladding panel, the frame including a portion having a box section attached thereto, the box section including the channel, and at least one weatherseal arranged to seal the box section to the cladding panel and direct rainwater from the cladding panel into the channel.

26. Apparatus according to claim 25 wherein the framing section includes a compression plate to hold the box section outwardly, in use.
27. Apparatus according to claim 25 or claim 26 wherein the box section is subdivided by a stiffening member to create a closed chamber for structural properties and an open chamber forming the channel for the collection of rainwater.

28. Apparatus according to any one of claims 25 to 27 wherein the box section includes an upper face which is open for the passage of rainwater into the channel.

29. Apparatus according to any one of claims 25 to 28 wherein the box section includes lift out sections.

30. Apparatus according to any one of claims 25 to 27 wherein the box section includes a cover over the upper face and wherein the cover includes apertures for the rainwater to pass therethrough.

31. Apparatus according to claim 30 wherein apertures are open collection slots.

32. Apparatus according to claim 30 or claim 31 wherein the cover is a perforated grating.

33. Apparatus according to any one of claims 25 to 31 wherein the apparatus further comprises at least one cladding panel.

34. Apparatus according to claim 33 wherein the cladding panel is a curtain walling screen.

35. Apparatus according to claim 33 wherein the cladding panel is a glazing panel.
Fig. 1a

Fig. 1b

Fig. 1c

Fig. 1d

Fig. 1e
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER
INV. E04B/96 E04D13/08 E04D13/064

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED
Minimum documentation searched (classification system followed by classification symbols)
E04B E04D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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<td>GB 2 423 098 A (JOHNSON E VAN [GB]) 16 August 2006 (2006-08-16) abstract; figures 1,10 column 7, line 12 - line 23</td>
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<td>A</td>
<td>DE 11 92 809 B (FENESTRA CRITTALL A.G) 13 May 1965 (1965-05-13) the whole document</td>
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D. Further documents are listed in the continuation of Box C

See patent family annex.

Date of the actual completion of the international search: 21 October 2008
Date of mailing of the international search report: 28/10/2008

Name and mailing address of the ISA/Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040,
Fax: (+31-70) 340-3016
Demeester, Jan
<table>
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